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EPA Proposed Plan for Ashland/Northern States Power Lakefront Site

Ashland, Wisconsin June 2009

Aerial photo shows the Ashland Lakefront site. The Upper Bluff/Filled Ravine includes the location of the former manufactured gas facility that created much of the pollution on the site.

This Proposed Plan identifies EPA's Preferred Alternative to clean up contaminated soil, ground water and sediment at the Ashland/Northern States Power (NSP) Lakefront site. The site is contaminated with waste tar from a former manufactured gas plant (MGP) and some contaminated areas also contain wood debris and other solid waste from former lumber mills and an open dump that once operated on what is today Kreher Park. The Preferred Alternative would clean up the source materials (free product, NAPLs), which are the principal threat wastes at the site. In addition, the Preferred Alternative would address contaminated soil from the Upper Bluff/Filled Ravine and Kreher Park areas, contaminated sediment from the Chequamegon Bay, and contaminated groundwater in the shallow aquifer and the Copper Falls aquifer, which underlies Kreher Park and the Upper Bluff/Filled Ravine area. It is EPA's current judgment that the Preferred Alternative identified in this Proposed Plan is necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment. Under EPA's Preferred Alternative contaminated soil and sediment would be dug up and treated on-site and used as clean fill or disposed off-site. In addition, contaminated ground water would be contained using barriers and pumped and treated on-site. EPA is the lead agency and the Wisconsin Department of Natural Resources (WDNR) is the support agency for activities at the site.

EPA's remedial action objectives (RAOs) for the site are to protect people's health and the environment by:

- Eliminating or reducing potential risks to human health and the environment from exposure to contaminants;
- Removing contamination, treating contaminated materials, and containing remaining contaminants to lessen effects of discharge to the air, land, sediment, or water;
- Stopping or minimizing the movement of contaminants to Kreher Park and Chequamegon Bay;
- Removing or reducing contaminants in soil and ground water located on the upper bluff at the former manufactured gas plant and the filled ravine above Kreher Park;
- Removing or reducing contaminants in soil and ground water at Kreher Park;
- Removing or reducing contaminants in sediments in Chequamegon Bay;
- Minimizing short-term risk to human health and the environment from exposure to contaminants during the cleanup; and
- Ensuring future beneficial use of land at the site.

Public Comment Needed

The purpose of this Proposed Plan is to provide background information about the Ashland/NSP Lakefront site, describe the various cleanup alternatives considered, and explain EPA's recommended cleanup. The public is encouraged to comment on this Proposed Plan. EPA will be accepting comments from June 17 through July 16, 2009. EPA is issuing this proposed plan as part of its public participation responsibilities under Section 300.430(f)(2) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

EPA, in consultation with WDNR, will select a final cleanup plan for the Ashland/NSP Lakefront site. This will occur after review and consideration of information given by the public during the 30-day public comment period and at the public meeting. The final cleanup plan, which will be announced in a local newspaper notice and presented in an EPA document called a record of decision (ROD), could differ from the proposed plan depending on information or comments EPA receives during the public comment period.

Additional Information Available for Review

The public also is encouraged to review the supporting documents for the Ashland site. The information includes the remedial investigation (RI) and the feasibility study (FS) reports and other documents (e.g., risk assessments). The remedial investigation is a study of the nature and extent of contamination at the site, while the feasibility study evaluates different cleanup options. The risk assessments evaluate potential risks to people and the environment from the contamination at the site. The public can review these and other supporting documents in the information repositories listed on the last page of this proposed plan and online at www.epa.gov/region5/sites/ashland.

Background about the Ashland /NSP Lakefront Site

The Ashland/NSP Lakefront site consists of the Upper Bluff/Filled Ravine, including properties owned by Northern States Power Company of Wisconsin (doing business as Xcel Energy), Our Lady of the Lake church and school, private residences, and a railroad corridor owned by Wisconsin Central, Ltd., part of Canadian National Railway (CN); a portion of Kreher Park, including the former wastewater treatment plant, owned by the City of Ashland; and approximately 16 acres of contaminated sediment in Chequamegon Bay. The cleanup alternatives considered for the site focused on four areas and related media: 1) the Upper Bluff/Filled Ravine (soil and ground water); 2) Kreher Park (soil and ground water); 3) Copper Falls aquifer (ground water only); and 4) Chequamegon Bay (sediments only).

Upper Bluff/Filled Ravine is the site of a former manufactured gas plant (MGP). The plant produced "water gas" for street and home lighting and other uses between 1885 and 1947. Coal tars were a by-product of the manufactured gas process. A ravine ran through the gas plant property, emptying out near the former Lake Superior shoreline near what is now the railroad corridor. The ravine was filled by the early 1900s. The NSP-owned property of the Upper Bluff/Filled Ravine still contains remnants of buildings and equipment from the plant and is now an NSP service facility. The property overlooks Kreher Park and is bounded by Lake Shore Drive, St. Claire Street, Prentice Avenue, and 3rd Avenue. The railroad, church and school, and private residences are also located in this area.

Kreher Park, between Prentice and Ellis Avenues, is located on Chequamegon Bay. The park did not exist before the late 1800s as the historic shoreline was much closer to what is now the railroad corridor. Kreher Park was created over the decades as various fill materials were placed into the bay. The eastern portion was filled with sawdust, wood waste and other material from local sawmills, including the former Schroeder Lumber Co. that operated until the early 1930s. Between 1880 and 1951 solid waste, primarily demolition debris, was disposed in an open dump along the western side of the park. In 1942 the City of Ashland took ownership of most of the park, including the former Schroeder Lumber property from Ashland County. In 1986 the City acquired a smaller portion on the western end of the park, including the former open dump. An area in Kreher Park at the bottom of the filled ravine is marked as a "coal tar dump" on a 1951 map included in the City of Ashland's plans for the waste water treatment plant. The wastewater treatment plant is located on the bay inlet on the north side of the park and operated from 1952 to 1991. Today, while the buildings of the former waste water treatment plant remain, Kreher Park is mostly grass covered and a gravel overflow parking area for the marina occupies the west end of the property.

Copper Falls aquifer is a thick water-bearing formation composed of layers of sand and gravel that lies underneath the Upper Bluff/Filled Ravine and part of Kreher Park. This aquifer is overlain by about 30 feet of clay/silt known as the Miller Creek Formation. The Miller Creek Formation provides a hydraulic barrier that separates the deep aquifer from the shallow groundwater encountered in Kreher Park and surface water in the bay. Groundwater contamination in the underlying Copper Falls aquifer is the result of former manufactured gas plant operations.

The **Chequamegon Bay** impacted area of the site is roughly sixteen acres between the boat marina and the Prentice Avenue boat launch extending out about 300 feet from the shoreline. The contaminated sediments in the bay consist of lake bottom sand and silts that mixed with wood debris from the historic log rafting and lumbering operations. The wood debris layer is up to six feet thick in areas, with an average thickness of nine inches. Wastes including tars and oils moved from the former MGP to the park and the bay through the open ravine, and later, after the ravine was filled, through a pipe buried inside the ravine. Later, after Kreher Park was filled in, additional pipes and a ditch may have conveyed waste from the "coal tar dump" to the bay. Other activities in the area, including possible wood treatment at local sawmills and construction and expansion of the former municipal wastewater treatment plant in what is now Kreher Park, may have transported contamination to the bay.

Cleanup actions taken so far

Site pollution was discovered in 1989 when the City of Ashland encountered oil and tar in excavations while preparing to expand the former wastewater treatment plant.

The wastewater treatment plant was later closed and a new one was built in another location. During the 1990s both WDNR and NSP performed a series of investigations to assess contamination at Kreher Park, at the NSP property and Chequamegon Bay.

In 2000, NSP began pumping out ground water from the Copper Falls aquifer as a pilot project. The pumped water is treated at the NSP plant and discharged into the city's sanitary sewer. So far, more than 1.7 million gallons of contaminated water have been pumped out, yielding about 10,000 gallons of coal tar. Also, in 2002, NSP installed an extraction well and dug out contaminated soil and removed tar at a seepage point in Kreher Park at the base of the bluff and removed much of the buried pipe in the filled ravine. This area was then covered with clean material.

In response to a citizen's petition, EPA added the site to the National Priorities List (NPL) in 2002. NSP signed an agreement with EPA in 2003 to conduct the remedial investigation/feasibility study (RI/FS) under EPA oversight. The RI/FS identified the types, quantities and locations of contaminants and developed cleanup alternatives. As part of the RI/FS, NSP conducted a human health and ecological risk assessment that will be used to set cleanup goals for the site. EPA will select a remedy after considering the comments received from the public on the Preferred Alternative presented in this Proposed Plan.

Site Pollution

Contamination at the site was primarily generated by the former MGP and has affected soil, ground water and sediment. The primary contaminants are derived from tar compounds, including volatile organic compounds (VOCs) and polycyclic aromatic hydrocarbon (PAH) compounds. The most abundant compounds from each of these groups include benzene (VOC) and naphthalene (PAH). Additionally, some free-phase hydrocarbons (free product) derived from the tars is present as a non-aqueous phase liquid (NAPL). Free-product includes both light non-aqueous phase liquid (LNAPL) and dense non-aqueous phase liquid (DNAPL). The most commonly occurring contaminants at the site and a brief explanation of the contaminants are as follows:

Carburated Water Gas Tar/Oil Wastes
These wastes are a mixture of chemicals that make up part of the liquid waste from the gas production process sometimes referred to as coal tar. This tarry/oily substance is a mixture of hundreds of chemical compounds including VOCs, Semi-Volatile Organic Compounds (SVOCs), and PAHs (listed below) and is found throughout the site.

Volatile Organic Compounds (VOCs) and Benzene
VOCs are organic chemicals that evaporate readily into the atmosphere. VOCs are found in many things, from paints and coatings to deodorants and cleaning fluids. The most commonly-occurring VOC at the Ashland site is benzene. Benzene is a colorless liquid with a sweet odor.

Semi-Volatile Organic Compounds (SVOCs)
SVOCs are organic compounds that evaporate slowly at standard temperatures over a longer period of time than VOCs. A variety of SVOCs are used in building materials to provide flexibility, water resistance or stain repellence as well as inhibit ignition or flame spread.

Polycyclic aromatic hydrocarbons (PAH) and Naphthalene
PAHs are a group of over 100 different chemicals that are formed during the incomplete burning of coal, oil and gas and other organic substances. The most commonly-occurring PAH at the Ashland site is naphthalene. Naphthalene is a strong smelling PAH which is derived from coal tar or petroleum.

Contaminants at the site are also associated with non-aqueous phase liquids.

Non-Aqueous Phase Liquid (NAPL), also known as "Free Product"
Free product or NAPLs are underground pockets of tar and other materials in liquid form that don't readily mix with water and are separated into floating or sinking masses known as LNAPL and DNAPL.

Light Non-Aqueous Phase Liquid (LNAPL)
LNAPL is a non-aqueous phase liquid containing lighter volatile organic compounds that float on top of the water table and do not readily mix with water. Most common petroleum hydrocarbon fuels and lubricating oils such as benzene are LNAPLs.

Dense Non-Aqueous Phase Liquid (DNAPL)
DNAPL is a non-aqueous phase liquid containing heavier volatile organic compounds that sink through the water table and do not readily mix with water. PAHs such as naphthalene are DNAPLs and typically sink to the bottom of the aquifer instead of floating on top of the water table

Tar compounds and free product found their way into soil, ground water and the bay, and the underlying debris at Kreher Park. Test pits dug in the park revealed an oily sheen running through the fill material. When there are large waves on Lake Superior, NAPL compounds are stirred up from the bay sediment and cause oil slicks on the surface of the bay.

Summary of Site Risks

EPA reviewed and approved a human health risk assessment and a baseline ecological risk assessment which identifies how people and wildlife might be exposed to contamination at the site. These risk assessments use a required assumption that contamination is not cleaned up and there are no restrictions, fences, or signs to prevent people from being exposed. While some potential exposures are very unlikely, others are very possible or even known to have occurred at the site.

Human Health Risk Assessment

The results of the human health risk assessment (HHRA) indicate that five exposure pathways result in estimated risks that exceed EPA's target risk levels and seven exposure pathways result in estimated risks that are either equivalent to or exceed the EPA target risk range of $1x10^{-4}$ to $1x10^{-6}$ and the WDNR threshold of 1×10^{-5}. These exceedances are indicated in Table 1 on Page 30.

These include estimates for the reasonable maximum exposure (RME) scenarios for potential cancer risks and non-cancer risks. These conclusions are based on assumed exposures to soil in the filled ravine area (for residential receptors) and the filled ravine, upper bluff and Kreher Park area (for construction worker receptors), and to indoor air samples collected at the NSP Service Center. Carcinogenic risks based on central tendency evaluation (CTE) scenarios indicate that the residential receptor exposure to soil (all soil depths to 10 feet bgs) are estimated to be at 1×10^{-4}, the upper-end of the EPA target risk range. Carcinogenic risks based on the RME scenarios for residential receptor exposure to soils for all depths exceed 1×10^{-4}, the upper-end of the EPA target risk range. Non-carcinogenic risks for the residential receptor (for soil depths 0-1 foot and 0-3 foot bgs) and risks associated with the construction scenario are within acceptable levels. However, residential receptor exposure to subsurface soil is not expected, given the current and potential future land use of the Site. For this Site, residential risks associated with CTE exposures to surface soil (0 to 1 foot bgs) are within the target risk ranges, but the RME exposures exceed the target risk range. (The CTE exposures are not included in the Table 1.)

Although the results of the HHRA indicate risks for construction workers under the RME conditions exceed EPA's target risk levels, the assumptions used to estimate risks to this receptor were conservative and assumed the worst case. Given both the current and future land use of the Site, it is unlikely that construction workers would be exposed to soil in the filled ravine and Upper Bluff. The most likely scenario for the future construction worker is exposure to soil within 0 to 4 feet bgs in Kreher Park (a typical depth for the installation of underground utility corridors), as most activities associated with the implementation of the future land use would be associated with re-grading, landscaping, and road or parking lot construction. However, the depth to groundwater in Kreher Park is relatively shallow due to the lake-filled material comprising most of the park. Consequently, it is possible that construction workers excavating and installing utilities in such underground corridors in certain portions of Kreher Park may encounter contaminants of concern (COCs) that impacted sub-surface soils and NAPLs in groundwater.

For non-cancer risks, a hazard index (HI) of 3 was calculated for the general industrial worker exposure to indoor air pathway under the RME conditions.

Cancer risks to the subsistence fisher (finfish) are equivalent to 1×10^{-4}, the upper-end of the EPA target risk range and greater than the WDNR threshold. Non-carcinogenic risk is within acceptable limits for both EPA and WDNR.

Risks to recreational children (surface soil) are equivalent to 1×10^{-5}, which is the WDNR cancer risk threshold. However, risks to adolescent and adult receptors exposed to surface soil are below the EPA acceptable risk range and below the WDNR risk threshold.

Risks to waders and swimmers (sediments), industrial workers (surface soil), and maintenance workers (surface soil) are all within EPA's target risk range of 10^{-4} to 10^{-6} for lifetime cancer risk and a target HI of less than or equal to 1 for non-cancer risk. The risks are also less than the WDNR threshold of 1×10^{-5} for lifetime cancer risk and a target HI of less than or equal to 1 for non-cancer risk. Risks to recreational users (waders and swimmers) when an oily slick appears on the surface water were not assessed, but modeling by the risk assessment suggested that oil slicks floating on the surface water would pose a health risk for people who swim or wade at the site.

Risks were also estimated for construction workers exposed to "oily materials" in groundwater via dermal contact and swimmers and waders who may be exposed to oil slicks in surface water via ingestion and dermal contact. Because no media-specific concentrations are available for either scenario, risks were estimated using analytical data collected from the product stream from the active free product recovery system for the Copper Falls aquifer or chemical-specific solubility values detected in the DNAPL sample. Risks to construction workers exposed to "oily material" in groundwater and adult swimmers and waders exposed to "oil slicks" in surface water is greater than both the EPA upper risk range (CR 1×10^{-4} and HI of 1) and the WDNR threshold (CR 1×10^{-5} and HI of 1). However, it is important to note that there is uncertainty associated with estimating risks to oily material in groundwater or oil slicks in surface water.

Sports fish from the site do not contain harmful levels of site-related contamination, but recent testing of some smelt at the site found unacceptable contaminant levels. People should continue to follow the general Lake Superior fish consumption advice available from the Ashland County Health Department.

Baseline Ecological Risk Assessment

In the ecological risk assessment nine groups of wildlife were studied for pollution effects. Contamination posed little direct risk to birds, mammals and fish although occasionally contaminants are stirred up and cause an oily slick on the surface of the bay where it could potentially affect wildlife. The risk assessment did find that contamination is harming the benthic community or tiny organisms that live at the bottom of the bay and form the base of the food chain.

However, the fact that hydrocarbons are released from the Site sediment during some high energy meteorological events or when disturbed by other activities indicates the potential for impact to the benthic community that may not have been fully measured by the studies conducted to support the RI. While there is no evidence that effects from these releases will lead to impairment of populations and communities of these receptors inhabiting the waters of Chequamegon Bay, it remains a source of uncertainty. It is possible that the presence of this continuing source of site related contaminants (free product) may impair the healthy functioning of the aquatic community in the Site area.

In addition, if normal lake front activities, i.e., wading, boating etc., were not presently prohibited, the disturbance of sediments and contaminant release of subsurface COCs would increase. This potentially could lead to greater detrimental impacts than were measured during the RI/FS studies.

Summary of Cleanup Alternatives

There are many ways to clean up pollution and a number of cleanup techniques for soil, ground water, and sediment went through a complex screening process explained in the feasibility study. These cleanup alternatives were evaluated by each of the nine criteria required by law. To organize all of these cleanup alternatives for soil, ground water and sediment and the numerous combinations, the feasibility study formed 10 cleanup "scenarios." The scenarios incorporate a combination of techniques to address contamination in soil, ground water and sediment. For a more complete description of alternatives and comparison to other alternatives considered please consult the feasibility study. In this "Summary of Cleanup Alternatives" section each separate cleanup alternative for soil, ground water and sediment is described. The "Evaluation of Alternatives" section then compares each separate alternative against the nine criteria and each other.

Soil cleanup alternatives

S-1: No action. This alternative must be considered at every Superfund site. It means leaving contaminated soil in place with no engineering, maintenance or monitoring.
Cost: $0

S-2: Containment using engineered surface barriers
This means covering an area with a barrier to stop rain and snow melt from seeping through the contamination and into the ground water and lake. This would also stop wind from blowing contaminated soil and protects people and animals from direct contact. Surface barriers that stop direct contact with below surface soil can include an asphalt cap; clay cap; multi-layer cap with a clay barrier, drainage layer, soil, and vegetated top soil cover; and multi-layer cap with a liner made of heavy plastic material. In areas of the Upper Bluff/Filled Ravine and Kreher Park asphalt pavement would be replaced and new asphalt pavement installed. A solid cap would be placed over the former coal tar dump area in Kreher Park. Surface barriers will be periodically inspected

and repaired or replaced as needed. The amount of soil contained in the most contaminated areas is about 39,800 cubic yards. **Estimated cost: $1.9 million**

S-3A: Limited removal and off-site disposal
This means digging up and removing contaminated soil from the most contaminated areas in portions of Kreher Park and the Upper Bluff/Filled Ravine area. The upper bluff area requires removal of material from two areas of the filled ravine and at the coal tar dump area in Kreher Park. Limited removal would involve demolishing the center section of the NSP service center, removing asphalt pavement, and digging up former gas holders. Ground water seeping into the excavated area would be collected, placed in a holding tank and treated before discharge to the sanitary sewer. After excavation areas of the site would be restored with clean fill material, new asphalt pavement, and an existing street would be upgraded. Heavy moving equipment such as back hoes, bulldozers, and front-end loaders are used for digging. About 14,350 cubic yards of soil would be removed during limited soil removal. This limited removal and off-site disposal alternative transports contaminated soil to an off-site landfill or landfills for disposal. Contaminated soil that is not removed would be contained on-site to avoid any future exposure. **Estimated cost: $4.9 million**

S-3B: Unlimited removal and off-site disposal
This means digging up all contaminated areas of the Upper Bluff/Filled Ravine and Kreher Park and digging would stop when tests show contamination in the soil had dropped to safe levels. At the upper bluff area this will require the excavation of all fill material from the filled ravine, demolishing the center section of the NSP service center, removing asphalt pavement, and digging up former gas holders. After excavation, areas of the site would be restored with clean fill material, new asphalt pavement, and an existing street would be upgraded. At Kreher Park small trees and bushes would be cleared. Layers of wood waste and clean fill over the waste would be dug up and because digging would be done below lake level a temporary sheet pile wall would be constructed to allow for dry excavation. Ground water that seeps into the excavated area would be collected, placed in a holding tank and treated before discharge to the sanitary sewer. Removal of all fill material in Kreher Park would likely require the construction of a landfill and may result in the temporary or permanent loss of the current use of Kreher Park. After digging, Kreher Park could be restored to a wetland area or backfilled with clean material to restore it to its present elevation. Heavy moving equipment such as back hoes, bulldozers, and front-end loaders would be used for digging. About 259,600 cubic yards of soil would be removed. The contaminated soil would be transported to an off-site landfill or landfills for disposal.

- Unlimited removal and off-site disposal and backfill Kreher Park to its current elevation. **Estimated cost: $42.9 million**

- Unlimited removal and off-site disposal and restore Kreher Park as a wetland. **Estimated cost: $45.1 million**

S-4A: Limited removal and on-site disposal
This is the same as S-3A except with disposal on-site. At Kreher Park there is enough space for the construction of an on-site disposal cell. This could accommodate all or a portion of the contaminated material removed from the filled ravine and the contaminated soil from Kreher Park's coal tar dump area. A solid cap would be placed over the disposal cell. The cost includes constructing the one-acre disposal cell at Kreher Park. **Estimated cost: $3.8 million**

S-4B: Unlimited removal and on-site disposal
This is the same as S-3B except with disposal on-site. At Kreher Park there is enough space for the construction of an on-site disposal cell. This on-site disposal cell could accommodate all or a portion of the contaminated material removed from the filled ravine and contaminated soil from Kreher Park. A solid cap would be placed over the disposal cell. The cost includes constructing the four-acre disposal cell at Kreher Park. **Estimated cost: $6.4 million**

S-5A: Limited removal and thermal treatment ***(EPA recommends this for soils)***
Soil with the highest levels of contamination will be removed and treated thermally on-site. Treated soil will be returned to the site and used as clean fill. Thermal treatment is a way to remove contaminants from soil by heating it in an on-site mobile unit. Wood waste and other debris would be separated from the soil before treatment and the waste and debris would be transported off-site for disposal. The mobile unit for thermal treatment would be set up at Kreher Park. If treating contaminated soil after removal is not cost-effective, then off-site disposal would be the preferred option. Thermal treatment will be evaluated during the pre-design. Contaminated soil that is not removed and treated would be contained on-site to avoid any future exposure. **Estimated cost: $6.8 million**

S-5B: Limited removal and off-site incineration
Contaminated soil suitable for incineration would be transported off-site to a licensed or permitted facility for treatment and disposal. Wood waste and fly ash and cinders must be separated from soil selected for incineration and would be transported off-site for disposal. Fill material not contaminated will be returned and used as a backfill. Contaminated soil that is not removed would be contained on-site to avoid any future exposure. **Estimated cost: $11.8 million**

S-6: Limited removal and soil washing
Soil washing mechanically scrubs dug up soil to remove contaminants by dissolving or suspending them in a wash solution. The wastewater would be treated on site before discharge. A mobile unit would be used to wash the soil on-site. Wood waste would be separated from the soil and transported off-site for disposal. Contaminated soil that is not removed would be contained on-site to avoid any future exposure. **Estimated cost: $8.3 million**

Ground water cleanup alternatives

A number of ground water cleanup methods were evaluated. In general, installing wells to deliver treatment may be difficult and effectiveness may be limited in areas of shallow ground water where there are buried structures and debris such as wood waste, bricks, and cinders. Some treatment would not work for the Copper Falls aquifer because this deep aquifer is confined by the Miller Creek rock formation and installing certain treatment wells may compromise the confinement. Alternatives GW-3 through GW-8 are in-place ground water treatment alternatives.

GW-1: No action. This alternative must be considered at every Superfund site. This would mean leaving contaminated ground water in place with no engineering, maintenance or monitoring. **Cost: $0**

GW-2A and 2B: Containment using engineered surface and vertical barriers *(EPA recommends this for Upper Bluff/Filled Ravine and Kreher Park)*

This alternative would use man-made barriers to stop the movement of contaminants. Barriers stop water from coming into contact with contaminated soil. The Upper Bluff/Filled Ravine area would be capped as well as the coal tar dump area in Kreher Park. The marina parking lot will receive new asphalt pavement to further reduce water infiltration. Surface barriers do not disturb the contaminated area and only minimal maintenance is required. Vertical barrier walls are slurry walls or sheet piling that would be installed around the area of the contaminated ground water. A sheet metal wall would act as a vertical barrier and would be installed around the perimeter of the park. An additional sheet pile wall would be installed around the shore of the bay and installed at an approximate depth of 25 feet to allow for the off-shore removal of contaminated sediments to 10 feet. Contaminated material may be disturbed during construction of vertical barrier walls and long-term maintenance such as ground water extraction may be required. Vertical barriers would not work for the Copper Falls aquifer because this deep aquifer is confined by the Miller Creek rock formation and installing barrier walls could compromise the aquifer. Clearing trees and digging a ground water diversion trench would also be installed along with the surface and vertical barriers.

Long-term operation and maintenance of the containment would include removing contaminated ground water with added ground water extraction wells and annual inspection of surface barriers. A minimum of 15 groundwater extraction wells would be installed to remove contaminated groundwater and reduce the hydraulic head in the confined area. Contaminated ground water would be sent for on-site treatment before discharge to a sanitary or storm sewer. Discharge to the sanitary sewer would require approval from the City wastewater treatment plant. Discharge to a storm sewer would require a Wisconsin Pollutant Discharge Elimination System (WPDES) permit. A cap for the entire Kreher Park would result in significant disturbance and added costs. Long-term operation, maintenance and monitoring costs may be lower if capping the entire Kreher Park reduces the volume of ground water extraction.

GW-2A: Containment for the filled ravine and partial capping at Kreher Park.
Estimated cost: $9.2 million *(EPA recommends this)*

GW-2B: Containment for the filled ravine and capping the entire Kreher Park.
Estimated cost: $10.9 million

GW-3: In-place treatment using ozone sparge (*EPA recommends this or GW-6)*
This treatment injects ozone into the ground through wells to clean up ground water contamination. Ozone is a gas that decomposes and reacts with contaminants in water. Ozone does not work for NAPLs. Ozone sparging can be used at the Upper Bluff/Filled Ravine, at Kreher Park and in the underlying Copper Falls aquifer. This treatment technology will be evaluated as part of the design of the final selected remedy for groundwater and compared to the chemical oxidation treatment discussed in GW-6 below. **Estimated cost: $3.5 million**

GW-4: In-place treatment using surfactant injection and removal using dual phase recovery
Wells would be installed below the Miller Creek rock formation at the Copper Falls aquifer. A "wetting agent" would be injected to lessen the tension between NAPLs and water. Contaminated water would be pumped out through wells to the surface and water would be placed in a tank, treated, and discharged. Site conditions at the Upper Bluff/Filled Ravine and Kreher Park areas would limit effectiveness of this alternative.
Estimated cost: $1.4 million

GW-5: In-place treatment using permeable reactive barrier walls
Permeable reactive barrier (PRB) walls would be built below ground to clean up ground water at the Upper Bluff/Filled Ravine and Kreher Park. The walls have tiny holes that allow ground water to flow into the wall, which then traps and treats contaminants, resulting in clean ground water flowing out the other side of the wall. Site preparation for the PRB would involve clearing small trees and bushes, possible demolition of the former wastewater treatment plant, and digging a sheet pile wall along the shoreline and a trench at Kreher Park. **Estimated cost: $6.2 million**

GW-6: In-place treatment using chemical oxidation *(EPA recommends this or GW-3)*
Chemicals would be injected into wells to break up pollution in ground water. Hydrogen peroxide is an oxidant that is commonly used to break up contaminants in ground water and this method was used in a demonstration at this site. Hundreds of holes would be drilled in the filled ravine and at Kreher Park and injected with the chemical.
Estimated cost: $10 million

GW-7: In-place treatment using electrical resistance heating (ERH)
This treatment delivers electric current underground to convert ground water and water in soil to steam and to evaporate contaminants. It is assumed that ground water would be extracted for six to twelve months while the ERH system is operating. **Estimated cost: $16 million**

GW-8: In-place treatment using steam injection
Steam injection forces steam underground through wells drilled in contaminated areas. The steam heats the area and gathers, evaporates and breaks down contaminants. A soil vapor extraction system and/or a ground water extraction system would also be in place. Steam injection can be completed within a short period of time and long-term monitoring would be required. **Estimated cost: $12.5 million**

Ground water extraction and treatment
Also called pump and treat, extraction wells with pumps pull contaminated ground water to surface holding tanks and then into treatment systems. Ground water extraction wells can be used for both shallow and deep ground water. Enhanced ground water extraction would install additional extraction wells in the Copper Falls aquifer to increase DNAPL removal and include continued operation of the existing wells. Ground water extraction requires installing an on-site treatment system to operate for an extended period of time. Alternatives GW-9A and GW-9B are extraction and treatment alternatives.

GW-9A: Existing ground water extraction system
The existing ground water extraction system extracts ground water from one well at the mouth of the filled ravine and DNAPL from low flow wells installed in the underlying Copper Falls aquifer. Contaminated ground water is placed in a holding tank and then treated. **Estimated cost: $3 million**

GW-9B: Enhanced ground water extraction systems *(EPA recommends this for the Copper Falls aquifer)*
Same as GW-9A with wells added in the Copper Falls aquifer. Because ground water extraction can be a relatively slow process adding more wells would speed up the ongoing ground water cleanup. **Estimated costs: Upper Bluff/Filled Ravine - $164,000, Kreher Park - $18.9 million, and Copper Falls aquifer- $6.4 million**

Sediment cleanup alternatives
The goal for sediment is to clean up areas in Chequamegon Bay with contaminant levels greater than 9.5 parts per million PAH in sediment. This covers approximately 16 acres of the bay.

Mechanical and hydraulic are common dredging techniques. A clamshell bucket to dig up sediment is an example of equipment used for mechanical dredging. A hydraulic auger and cutter head are equipment used in hydraulic dredging to vacuum up sediment. Contaminated sediment would be removed to a barge. Dry excavation or "dry dredge" would involve building a wall off the shoreline, pumping out water and letting the bay bottom and shoreline dry before removing all contaminated sediment.

In designing a dredging project a number of factors must be considered, including physical obstructions, site access, staging areas, potential release of contaminants during dredging, the safety of workers and residents during the dredge, and community disturbance. Kreher Park would be used as a staging area for sediment removal activities including storing, stabilizing and treating dredged material. Precautions would be taken such as paving the marina parking lot to make sure contaminated sediment does not affect the soil underneath the staging area. Wood debris removed would be disposed or treated separately. Water would be drained from the sediment and the resulting wastewater would be treated and discharged into the lake. Removing water from sediment is called "dewatering."

All of the dredging alternatives assume a barrier (e.g., sheet pile) will be placed between upland areas in Kreher Park and the bay to prevent the recontamination of bay sediments after the dredge. The need for a barrier/seawall at the mouth of the bay to control wave action and prevent the migration of suspended contaminants out into the lake during dredging operations is anticipated and will be evaluated during pre-design pilot testing.

As detailed in the feasibility study, the sediment alternatives SED-3, SED-4, SED-5 and SED-6, all have a thermal treatment and off-site disposal option. However, if treating contaminated sediment after removal is not cost-effective, then off-site disposal would be the preferred option. Thermal treatment will be evaluated during the pre-design.

SED-1: No action. This alternative must be considered at every Superfund site. It means leaving the contaminated sediment in place with no engineering, maintenance, or monitoring. **Cost: $0**

SED-2: Sediment containment within a confined disposal facility and monitoring
A confined disposal facility (CDF) is an enclosure where contaminated sediment is placed and then capped with clean soil. The CDF would be constructed over about seven acres of lake bed and 13 acres of upland in Kreher Park. Sheet piling would be used to enclose the CDF and prevent contaminants from migrating. The CDF would be intended to contain all of the contaminated sediment and soil. Wood debris would be separated from sediment and sediment would be dewatered and treated before disposal in the CDF. Sediment with levels of PAH above 9.5 ppm outside the area of the CDF would be removed using hydraulic or mechanical dredging and placed in the CDF. About 70,000 cubic yards of sediment would be dredged. **Estimated cost: $35 million.**

SED-3: Dredging, capping, treatment and/or disposal, and monitoring
Mechanically or hydraulically dredge about four feet of wood debris and sediment with PAH greater than 9.5 ppm before capping with clean material. Dewater and stabilize the sediment, and either dispose sediment off-site after treatment or reuse after treatment. Off-site disposal would include loading sediment after drying and treatment or stabilization at the site and transporting it to a landfill. About 78,000 cubic yards of sediment would be dredged. Sediment areas outside the cap would be monitored.
Estimated cost range without and with treatment: $37.1 – $47.8 million

SED-4: Dredging, treatment and/or disposal, and monitoring
Mechanically or hydraulically dredge all sediment with PAH greater than 9.5 ppm, dewater and then thermally treat sediments on-site at Kreher Park before off-site disposal or reuse after treatment. Off-site disposal would include loading sediment after drying and treatment or stabilization at the site and transporting it to a landfill. After dredging

place a 6-inch cap of clean material over the work area. Under this alternative the greatest amount of sediment would be removed, treated and/or disposed off-site. About 134,000 cubic yards of sediment would be dredged. **Estimated cost range without and with treatment: $49.9 – $67.7 million**

SED-5: Dry excavation, treatment and/or disposal, and monitoring
Dry excavation in Chequamegon Bay would involve building a sheet pile wall off the Kreher Park shoreline, pumping out water and letting the bay bottom and shoreline dry before removing all contaminated sediment over 9.5 ppm. Dewater and stabilize the sediment, and either dispose sediment off-site after treatment or reuse after treatment. Off-site disposal would include loading sediment after drying and treatment or stabilization at the site and transporting it to a landfill. About 134,000 cubic yards of sediment would be excavated. **Estimated cost range without and with treatment: $78.9 – $91.8 million**

SED-6: Dry excavation (inner bay) and dredging (outer bay), treatment and/or disposal, and monitoring *(EPA recommends this)*
Use dry excavation near shore for wood waste and contaminated sediment with PAH greater than 9.5 ppm and mechanical or hydraulic dredging offshore for contaminated sediment with PAH greater than 9.5 ppm. Following dredging, sediments in the offshore area would be covered with at least 6 inches of clean material to control any residual contaminated surface sediments that my remain. Dredged material would be dewatered and stabilized at Kreher Park and either disposed off-site after treatment or reused after treatment. Off-site disposal would include loading sediment after drying and treatment or stabilization at the site and transporting it to a landfill. About 134,000 cubic yards of sediment would be dredged/excavated. EPA recommends the dry excavation alternative for the inner bay because of the high concentration of wood waste and free product in this area that could make dredging in water very difficult and cause the release of free product into the water resulting in the spreading of the free product and recontamination of the sediments. The dry excavation of the inner bay would also reduce the amount of water that will have to be dealt with and treated on the barge during the dredging operation. **Estimated cost range without and with treatment: $68.5 - $80.4 million**

Evaluation of Alternatives

In this section, the cleanup alternatives are evaluated by each of the nine criteria. For a more complete description of alternatives and comparison to other alternatives considered please consult the feasibility study.

Common elements for all alternatives
Several of the cleanup alternatives require institutional controls (i.e., deed restrictions such as easements or covenants) to limit the future use of portions of the property to prevent contact with contamination that remains at the site or to ensure that the contaminated water is not used for drinking water purposes after the cleanup is complete. In addition, long-term monitoring and maintenance on the surface barriers and sediment cap to make sure remaining buried pollution is not moving off-site is included in most alternatives. The type of controls on future use of the site that will be required to ensure

the long-term protectiveness of the cleanup will be determined in the record of decision, which selects the final cleanup plan. None of the cleanup alternatives EPA considered rely exclusively on institutional controls to achieve protectiveness. Monitoring and institutional controls to ensure the effectiveness of the cleanup are part of each alternative except the "no action" alternative.

EPA uses nine criteria to compare cleanup alternatives:

Threshold criteria are requirements each alternative must meet in order to be eligible for selection.

1. Overall protection of human health and the environment addresses whether an alternative adequately protects both human health and the environment. This standard can be met by reducing or removing pollution or by reducing exposure to it.

2. Compliance with applicable or relevant and appropriate requirements (ARARs) assures that each alternative meets federal and state laws, regulations, and other requirements that pertain to the site, unless a waiver is justified.

Balancing criteria are technical criteria with detailed analysis and are used to weigh major trade-offs among alternatives.

3. Long-term effectiveness and permanence evaluates how well an alternative will protect human health and the environment over the long term, including how safely contaminants that are left after the cleanup can be managed.

4. Reduction of toxicity, mobility or volume through treatment addresses how well the alternative reduces the toxicity (the chemical makeup of a contaminant that makes it dangerous), movement and amount of pollution.

5. Short-term effectiveness compares how quickly an alternative can help the situation and how much risk the alternative poses to workers, residents and the environment while it's being implemented.

6. Implementability evaluates the technical and administrative feasibility of the cleanup plan and whether materials and services are available to carry out the project.

7. Cost includes not only buildings, equipment, materials and labor but also the cost to put the plan in place and operate and maintain it over time. Cost estimates should capture all costs associated with the cleanup being considered and are expected to be accurate within a range of +50 to -30 percent. The cleanup alternative selected by EPA must be cost-effective. Under EPA's regulations, cost-effectiveness is determined by considering three of the five balancing criteria: long-term effectiveness and permanence; reduction in toxicity, mobility and volume of the waste through treatment; and short-term effectiveness (*see* 40 C.F.R. 300.430(1)(ii)(D)). Considering these three criteria, the overall effectiveness of the alternative is then compared to cost. The selected remedy is cost-effective if its costs are proportional to its overall effectiveness. The cost estimates for each cleanup alternative presented in this Proposed Plan are present net worth including a 30-year period of operation and maintenance and a 7% discount rate as per current EPA policy.

Modifying criteria can be fully considered only after public comment is received on the proposed plan.

8. State acceptance determines whether the state environmental agency, in this case WDNR, accepts the proposed cleanup plan.

9. Community acceptance determines what interested persons in the community and other stakeholders think about the proposed cleanup plan.

Based on information currently available, the recommended cleanup meets the threshold criteria and gives the best balance of tradeoffs among the other alternatives with respect to the balancing criteria.

Under Section 121(b) of CERCLA, cleanup alternatives in which treatment that permanently and significantly reduces the volume, toxicity or mobility of the contaminants is a principal element are to be preferred over alternatives that do not include treatment. The alternative selected must be protective of human health and the environment, cost effective, and utilize permanent solutions and alternative treatment technologies to the maximum extent practicable. An alternative that meets these objectives may be selected whether or not it has been achieved in practice at similar sites. Each of the soil, ground water and sediment cleanup alternatives was evaluated against the first seven of the nine criteria set by Superfund law. EPA picked its recommended alternatives based on the following justifications. State and community acceptance will be evaluated after EPA receives public comments.

The nine criteria described above are used to evaluate the different remediation alternatives individually and against each other in order to select a remedy. This section of the Proposed Plan profiles the relative performance of each alternative against the threshold and balancing criteria, noting how it compares to the other options under consideration.

1. Overall Protection of Human Health and the Environment

Soil Alternatives: ***Alternative S-1*** (no action) offers no additional protection for human health and the environment because no additional actions would be taken to address soil contamination at the Site. ***Alternative S-3B*** (unlimited removal and off-site disposal) offers the highest level of protection of human health and the environment in the long term because all fill and contaminated soil would be removed. ***Alternative S-3A*** (limited removal and off-site disposal), ***Alternative S-5A*** (limited removal and on-site thermal treatment), and ***Alternative S-5B*** (limited removal and off-site incineration) would also offer a high level of protection because these remedial responses would result in the removal of a significant mass of contaminated soil that exceed RAOs. ***Alternative S-6*** (limited removal and treatment by soil washing) would offer a moderate to high level of overall protection if this technology can be implemented to effectively reduce contaminant concentrations. ***Alternative S-2*** (containment using engineered surface barriers) would eliminate the direct contact exposure route, but would provide a low level of overall protection because soil (and groundwater) contamination would remain.

Alternatives S-4A and ***S-4B*** (limited and unlimited removal and on-site disposal) would provide a moderate level of protection because highly contaminated material from the upper bluff area and the former coal tar dump area would be consolidated into a disposal cell at Kreher Park.

Although unlimited removal for ***Alternative S-3B*** (unlimited removal and off-site disposal) would provide a high level of human health and environmental protection, limited removal for Alternatives S-3A, S-5A, S-5B, and S-6 would also provide a high level of protection because these remedial responses would result in the removal of a significant mass of contaminated soil that exceeds RAOs. Although Alternatives S-2 and S-4 would result in the containment of contaminated materials, which would be inaccessible to humans or biota, thereby reducing risk, the overall level of protection is lower because there is no reduction of contaminant mass.

Groundwater Alternatives: ***Alternative GW-1*** (no action) offers no additional protection for human health and the environment because no additional actions would be taken to address groundwater contamination at the Site. ***Alternative GW-2*** (containment using surface and vertical barriers) and ***Alternative GW-5*** (in-situ treatment using PRB walls) offer an overall moderate level of protection because contaminants will be left on site. Under these alternatives shallow ground water contamination would be contained and inaccessible to humans or biota, thereby reducing risk, but the alternatives offer no protection for the underlying Copper Falls aquifer. ***Alternative GW-9*** (removal using groundwater extraction wells) can be used for shallow and deep groundwater, but offers a moderate level of protection of human health and the environment in the long term because operation will require an extended period to achieve RAOs. Alternatives ***GW-4*** (surfactant injection and removal), ***GW-6*** (chemical oxidation), ***GW-7*** (ERH) ***and GW-8*** (steam injection), which all use in-situ treatment methods, offer adequate levels of protection because each alternative would result in the removal of significant contaminant mass, NAPL in particular, from the subsurface. ***GW-3*** (ozone sparge) is not effective in addressing NAPL.

Sediment Alternatives: ***Alternative SED-1*** (no action) offers the least protection of human health and the environment, as no additional actions would be taken to address contaminated sediments in the bay. ***Alternative SED-2*** (CDF) assures protection of human health and the environment by eliminating access to impacted sediment. Under this alternative, there is no destruction of COCs, but these materials would be permanently contained and inaccessible to humans or biota, thereby reducing risk. ***Alternative SED-3*** (subaqueous capping of a portion of the sediment and removal of the remainder) is also protective of human health and the environment, because it would isolate a portion of the sediment above the sediment Preliminary Remediation Goal (PRG) from exposure to humans or biota. The remaining sediment above the sediment PRG would be removed. If that portion is thermally treated it reduces its volume and permanently eliminates its toxicity by treatment. If the sediment were to be sent off-site for disposal without treatment, then this alternative reduces in-situ volume and eliminates exposure to humans and biota by transfer of these materials to an environment where access is controlled. There is no reduction in toxicity if the sediment that is removed is disposed in a landfill, although because access would be controlled there would be no exposure to humans or ecological receptors. ***Alternative SED-4*** (dredging) is also protective of human health and the environment if the sediment is treated, because it results in decontamination of sediment above the PRG and removes it from the aquatic environment. If the sediment were to be sent off-site for disposal without treatment, then this alternative would be roughly equivalent to Alternatives SED-2 and SED-3 (if Alternative SED-3 were also completed without sediment treatment); there would be no reduction in toxicity, but exposure to humans and biota is eliminated because access is controlled. There is no reduction in toxicity if the sediment that is removed is disposed in a landfill, although because access would be controlled there would be no exposure to humans or ecological receptors. ***Alternative SED-5 and SED-6*** (dry excavation or combination of dredging and dry excavation) is protective of human health and the environment if the sediment is treated, because it results in decontamination of sediment above the PRG and removes it from the aquatic environment. If the sediment were to be sent off-site for disposal without treatment, then this alternative would be roughly equivalent to Alternatives SED-2 and SED-3 (if Alternative SED-3 were also completed without sediment treatment); there would be no reduction in toxicity, but exposure to humans and biota would be eliminated because access is controlled. There is no reduction in toxicity if the sediment that is removed is disposed in a landfill, although because access would be controlled there would be no exposure to humans or ecological receptors.

2. Compliance with ARARs and To-Be-Considered (TBCs)

Soil Alternatives: ***Alternative S-1*** (no action) would not achieve compliance with ARARs and TBCs. ***Alternatives S-2, S-4A,*** and ***S-4B*** (surface barriers, and limited and unlimited removal and on-site disposal) must be implemented with a groundwater remedial response to achieve compliance. If properly implemented, the remaining remedial responses could achieve compliance with ARARs and TBCs for soil. Implementation would require that engineering and construction actions be developed and completed in compliance with federal and state regulations.

Groundwater Alternatives: ***Alternative GW-1*** (no action) would not achieve compliance with ARARs and TBCs. Compliance with ARARs and TBCs could be achieved for the remaining remedial alternatives for groundwater. Implementation would require that engineering and construction actions be developed and completed in compliance with federal and state regulations.

Sediment Alternatives: ***Alternative SED-1*** (no action) would not comply with regulations. ***Alternatives SED-2 and SED-3*** (CDF and subaqueous capping of a portion of the sediment and removal of the remainder) would require placement of a structure or deposit on the bed of navigable waters. The placement of a structure or deposit must not be detrimental to the public interest, must not materially reduce the flood flow capacity of a stream, and must not materially obstruct navigation. A confined disposal facility on the bed of Lake Superior does not meet these requirements for approval and, according to WDNR, cannot be permitted by the Department under Section 30.12, WI Statutes. A bulkhead line may be established under Section 30.11, Statute, however that bulkhead line must be in the public interest and shall conform as nearly as practicable to the existing shoreline. The proposed confined disposal facility in ***Alternative SED-2*** (CDF) would not follow the shoreline and would not meet the public interest standards and therefore cannot be established using this statutory authority. ***Alternatives SED-4 SED-5, and SED-6*** (dredging, dry excavation or combination of dredging and dry excavation) would be similar with respect to meeting ARARs and TBCs, as engineering and construction actions would be developed and completed in compliance with federal and state regulations.

3. Long-term Effectiveness and Permanence

Soil Alternatives: ***Alternative S-1*** (no action) would not provide any long-term benefit; no additional actions would be taken to address soil contamination at the Site. ***Alternative S-3B*** (unlimited removal and off-site disposal) would provide the highest effectiveness and permanence over the long term because all contaminated material and fill soil would be removed. ***Alternative S-3A*** (limited removal and off-site disposal), ***Alternative S-5A*** (limited removal and ex-situ thermal treatment), and ***Alternative S-5B*** (limited removal and incineration) would also be highly effective and permanent over the long term because these responses will result in the removal of a significant mass of contamination that exceeds RAOs. ***Alternative S-6*** (limited removal and treatment by soil washing) would provide a moderate level of effectiveness and permanence over the long term; effectiveness would depend upon the reduction in contaminant concentrations that can be achieved with this technology. The long-term effectiveness of ***Alternatives S-4A*** and ***S-4B*** (limited and unlimited removal and on-site disposal) is considered low to moderate because contaminants would remain on site in a disposal cell constructed at Kreher Park. The long-term effectiveness of ***Alternative S-2*** (containment using engineered surface barriers) is considered low because constituents would remain at the site beneath the surface barriers. However, for ***Alternatives S-2***, ***S-4A***, and ***S-4B***, contaminated material would be contained and inaccessible to humans or biota, thereby reducing risk. If properly implemented, a range of long-term effectiveness and permanence for all alternatives (except ***Alternative S-1)*** can be achieved for all active remedial responses for soil. ***Alternative S-2*** (surface barriers) must be implemented in conjunction with a remedial response for groundwater.

Groundwater Alternatives: ***Alternative GW-1*** (no action) would not provide any long-term benefit; no additional actions would be taken to address groundwater contamination at the site. ***Alternatives GW-2*** and ***GW-5*** (containment using surface and vertical barriers and in-situ treatment using PRB walls) offer low levels of effectiveness and permanence over the long term. Although risk would be reduced by containment of contaminated material, contaminants would be left on site. Additionally, both are limited to shallow groundwater; neither is a feasible alternative for the underlying Copper Falls aquifer. ***Alternative GW-9*** (removal using groundwater extraction wells) would provide a moderate level of effectiveness and permanence over the long term; operation would be required for an extended period to achieve RAOs. The remaining alternatives have high levels of effectiveness and permanence over the long term because each technology would result in the removal of a significant contaminant mass, NAPL in particular, from the subsurface.

Sediment Alternatives: ***Alternative SED-1*** (no action) would not provide any long-term benefit, as no remedial action would be taken and any potential risk associated with impacted sediment would remain. Although there would be no reduction in volume or toxicity of the contaminated sediment, ***Alternative SED-2*** (CDF) still provides a moderate level of permanence and effectiveness over the long term. Since no sediment is treated, the toxicity of the material remains the same, however accessibility and exposure to humans and biota is eliminated through containment. ***Alternative SED-3*** (subaqueous capping of a portion of the sediment and removal of the remainder) provides a high level of long-term effectiveness and permanence for that sediment which is removed and treated. For the contaminated sediment that is capped there is no destruction of COCs, but these materials are permanently contained and inaccessible to humans or biota, thereby reducing risk. If the sediment that is removed is not treated but disposed in an NR500 landfill exposure to humans and biota is eliminated through access restrictions. ***Alternatives SED-4, SED-5 and SED-6*** (dredging, dry excavation or combination of dredging and dry excavation) would provide the highest effectiveness and permanence over the long term due to the permanent removal of the largest volume of sediment. If treated, thermal treatment of the sediment would eliminate toxicity, reduce volume and is permanent. If the sediment that is removed is not treated but disposed in a licensed landfill, exposure to humans and biota is eliminated through access restrictions.

4. Reduction of Toxicity, Mobility, and Volume Through Treatment

Soil Alternatives: ***Alternative S-1*** (no action) would not result in a reduction in the toxicity, mobility, or volume of contaminated soil. ***Alternative S-3B*** (unlimited removal and off-site disposal) would result in the highest degree of reduction of toxicity, mobility, and volume of impacted material because all contaminated soil and fill material would be removed. ***Alternative S-3A*** (limited removal and off-site disposal), ***Alternative S-5A*** (limited removal and ex-situ thermal treatment), and ***Alternative S-5B*** (limited removal and incineration) would also result in a high degree of reduction of toxicity, mobility, and volume of impacted material because these remedial responses would remove a significant contaminant mass that exceeds RAOs. ***Alternative S-6*** (limited removal and treatment by soil washing) would result in a moderate degree of reduction of toxicity, mobility, and volume of contaminated soil, but would depend upon the reduction in contaminant concentrations that can be achieved with this technology. ***Alternatives S-4A*** and ***S-4B*** (limited and unlimited removal and on-site disposal) would offer a low to moderate reduction in the toxicity, mobility, and volume of contaminated soil at the Site. It would reduce the toxicity and a significant volume of contaminated soil at the upper bluff area and former coal tar dump area, but this material would be placed in a disposal cell at Kreher Park, which although reduces the mobility of contaminants does not reduce the volume or toxicity at Kreher Park. ***Alternative S-2*** (containment using engineered surface barriers) would not reduce the toxicity or volume of contaminated soil in unexcavated areas, but it would limit the mobility of contaminants by reducing infiltration, which would minimize contaminant leaching to groundwater.

Groundwater Alternatives: ***Alternative GW-1*** (no action) would not result in a reduction in the toxicity, mobility, or volume of contaminated groundwater. ***Alternatives GW-2*** and ***GW-5*** (containment using surface and vertical barriers and in-situ treatment) would not result in a reduction in the toxicity or volume of contaminant mass. However, both would reduce contaminant mobility for shallow groundwater, but not for the Copper Falls. ***Alternative GW-9*** (removal using groundwater extraction wells) would result in a reduction in the toxicity, mobility, and volume of contaminant mass, but operation would be required for an extended period to achieve RAOs. Implementation of the remaining in-situ treatment alternatives would result in the highest degree of reduction of toxicity, mobility, and volume of impacted groundwater. However, the amount of volume reduction would vary for each of the remaining in-situ treatment alternatives.

Sediment Alternatives: ***Alternative SED-1*** (no action) offers no reduction in toxicity, mobility, or volume through treatment, as no action would be taken. ***Alternative SED-2*** (CDF) would permanently reduce the mobility of contaminated sediments, although the toxicity and volume would not change. While there is no destruction of COCs, these materials would be permanently contained and inaccessible to humans or biota, thereby reducing risk. ***Alternative SED-3*** (subaqueous capping of a portion of the sediment and removal of the remainder) would reduce toxicity, mobility and volume of approximately 78,000 cubic yards of sediment which would be permanently removed from the environment. That sediment remaining under the cap would have permanently reduced mobility and since it would be inaccessible to humans or biota, it would eliminate exposure and risk. The inherent toxicity of that sediment remaining under the cap would not be reduced. ***Alternatives SED-4, SED-5, and SED-6*** (dredging, dry excavation or combination of dredging and dry excavation) would have the greatest degree of reduction of toxicity, mobility, and volume of impacted material. Mobility would be reduced by permanently containing it in a licensed landfill.

5. Short-term Effectiveness

Soil Alternatives: Implementation of ***Alternative S-1*** (no action) would not achieve RAOs or improve environmental impacts in the short-term. Because there is no remediation, there would be no exposure to the community and workers during implementation. The remaining alternatives would improve environmental impacts in the short-term, but require varying degree of effort to protect the community and workers during remediation. Implementation of ***Alternative S-3B*** (unlimited removal and off-site disposal) would result in the most significant on and off-site disturbance and require the highest levels of effort for this protection. ***Alternatives S-4A*** and ***S-4B*** (limited removal and on-site disposal) would result in no off-site disturbance; site disturbance would be limited to the site, and would require a moderate level of effort for protection. ***Alternative S-2*** (containment using engineered surface barriers) would result in minimal on-site disturbance, and no off-site disturbance. Because the remaining alternatives include limited removal of highly contaminated soil, they would require high levels of effort for worker and community protection. Engineered controls and monitoring would be implemented as needed for all alternatives to maximize short-term effectiveness for soil. ***Alternative S-2*** (surface barriers) must be implemented in conjunction with a remedial response for groundwater.

Groundwater Alternatives: Implementation of ***Alternative GW-1*** (no action) would not achieve RAOs or improve environmental impacts in the short-term, but it would not pose any implementation risks to the community and workers during remediation. The short-term effectiveness for the remaining alternatives is considered high. Each alternative can achieve RAOs and would reduce environmental impacts in the short term by removing contaminant mass or preventing the off-site migration of contaminants. The containment, in-situ, and removal technologies evaluated would require minimal effort to protect the community and workers during remediation.

Sediment Alternatives: ***Alternative SED-1*** (no action) would have the least short-term impact on human health and the environment, as impacted sediment would not be disturbed, and contaminants would not potentially be released into surface water and air. Of the five active remedial options, ***Alternative SED-2*** (CDF) would have the least short-term impact, as sediment would not be brought to shore for dewatering or treatment, but would be disposed in a CDF, a portion of which is subaqueous. Adequate controls would be in place to ensure worker and community safety during remedial activities. All other alternatives would have the potential of some short-term risk from release of volatile emissions during debris removal and onshore dewatering and/or treatment and transportation.

6. Implementability

Soil Alternatives: ***Alternative S-1*** (no action) would require the least amount of effort for implementability. ***Alternative S-3B*** (unlimited removal and off-site disposal) would result in significant site disturbance, and would be the most difficult to implement. ***Alternative S-6*** (limited removal and treatment by soil washing) may require a bench scale treatability study and pilot test to evaluate its implementability. ***Alternatives S-4A and S-4B*** (limited removal and on-site disposal) would require a variance from the State of Wisconsin for siting the landfill at Kreher Park. Obtaining a variance from the State of Wisconsin may be difficult, which could cause a significant delay in implementing the remedial response action. The remaining limited removal alternatives are highly implementable.

Groundwater Alternatives: ***Alternative GW-1*** (no action) would require the least amount of effort for implementability. ***Alternatives GW-2*** and ***GW-5*** (containment using surface and vertical barriers and in-situ treatment) have a very high degree of implementability. The remaining alternatives have a high degree of implementability. However, buried structures in the upper bluff area and the wood waste layer at Kreher Park may limit the effectiveness of in-situ treatment for shallow and deep groundwater in these areas. Removal of the buried structures concurrent with remedial alternatives evaluated for soil may ease implementation of the in-situ treatment and removal alternatives for the Copper Falls. If removal and disposal (on- or off-site) or on-site treatment is selected as a remedial response for soil, or if containment is selected for shallow groundwater, in-situ treatment and/or removal would not be necessary for soil and shallow groundwater contamination because the contamination is being addressed. However, one or more of the in-situ and/or removal technologies evaluated would be required for the Copper Falls aquifer.

Sediment Alternatives: Implementation of ***Alternative SED-1*** (no action) would be easy, as no action would be performed. ***Alternative SED-2*** (CDF) would be more difficult to implement than ***Alternative SED-1***. The technology and equipment that would be used for this alternative is readily available, and has proven to be reliable at other similar sites. However, because WDNR has indicated that the Governor and Legislature must approve ***Alternatives SED-2 and SED-3*** (CDF and subaqueous capping of a portion of the sediment and removal of the remainder), obtaining authorization to proceed is uncertain. The impact on schedule for implementation of the remedy would also be significant. Long-term monitoring, included as a part of ***Alternatives SED-2, SED-3, and SED-4*** (dredging), would allow periodic evaluation of risks associated with materials left in place. ***Alternatives SED-3 and SED-4***, which mechanically or hydraulically dredge about four feet of wood debris and sediment before capping, or mechanically or hydraulically dredge all sediments greater than 9.5 ppm, would be difficult to implement, as additional equipment, technology, and permitting would be required to perform the dewatering, thermal treatment, and disposal of sediment as well as for implementation of engineering controls for volatilization. The amount of wood waste and presence of free product also present difficult implementation challenges in order to control the release of contaminants and recontamination of sediments. Furthermore, the capping component included as part of Alternative SED-3 would add additional complexity to the implementation of this alternative. ***Alternative SED-5 and SED-6*** (dry excavation or combination of dredging and dry excavation) would be difficult to implement because of the need to install safe and watertight enclosures, pump the surface water out, keep water out that falls through precipitation, and engineering controls for volatilization. A dry excavation of the whole bay or inner bay only, however, is an efficient and effective way to remove the significant amount of wood waste and free product since there is no water and it is possible to see what is being removed without the need to control the release of free product to the water and recontamination of sediment.

7. Cost

Soil Alternatives: There are no costs associated with ***Alternative S-1*** (no action) because no remedial activities would be conducted. For the upper bluff area, the ***Alternatives S-3B*** (unlimited removal and off-site disposal) and ***S-5B*** (limited removal and incineration) yield the highest costs. ***Alternative S-6*** (limited removal and treatment by soil washing) yields the next highest cost, followed by ***Alternative S-5A*** (unlimited removal and on-site thermal treatment), ***Alternative S-3A*** (limited removal and off-site disposal), and ***Alternatives S-4A*** and ***S-4B*** (limited and unlimited removal and on-site disposal) yielded lowest costs for the upper bluff area. ***Alternative S-2*** (containment using engineered surface barriers) would be the lowest cost remedial response for soil in the upper bluff area, but would likely need to be completed in conjunction with a groundwater remedial response to be effective. ***Alternative S-3B*** (unlimited removal and off-site disposal) also yields a high cost for Kreher Park. ***Alternative S-4B*** (unlimited removal and on-site disposal at Kreher Park) yields the next highest cost followed by ***Alternative S-6*** (limited removal and treatment by soil washing), ***Alternative S-5A*** (limited removal and on-site thermal treatment), ***Alternative S-2*** (containment using engineered surface barriers), ***Alternative S-5B*** (limited removal and off-site incineration), and ***Alternative S-4A*** (limited removal and on-site disposal). ***Alternative S-3A*** (limited removal and off-site disposal) yields the lowest cost.

Groundwater Alternatives: There are no costs associated with ***Alternative GW-1*** (no action) because no remedial activities would be conducted. For shallow groundwater, ***Alternatives GW-2*** and ***GW-5*** (containment using surface and vertical barriers and in-situ treatment) have high installation costs. Annual operation and maintenance (O&M) costs for ***GW-2*** are high due to long-term groundwater recovery and disposal costs, but low for ***GW-5***, which relies on in-situ treatment. Cost for implementation of the in-situ treatment ***Alternatives GW-6*** (chemical oxidation), ***GW-7*** (ERH), and ***GW-8*** (steam injection) are also high with low annual O&M costs. ***Alternative GW-3*** (ozone sparging) has low implementation and annual O&M costs. Implementation costs for ***Alternative GW-9*** are the lowest, but it has high annual O&M costs for continued operation, which may be required for an extended period of time.

For the Copper Falls aquifer, in-situ treatment ***Alternatives GW-6*** (chemical oxidation), ***GW-7*** (ERH), and ***GW-8*** (steam injection) have high implementation costs. ***GW-6*** has high O&M costs, and ***GW-7*** and ***GW-8*** have low O&M annual costs. In-situ treatment ***Alternatives GW-3*** (ozone sparging), and ***GW-4*** (surfactant injection) have low implementation costs, but high annual O&M costs. As with shallow groundwater, implementation costs for ***Alternatives GW-9*** are the lowest, but it has high annual O&M cost for continued operation, which may be required for an extended period of time.

Sediment Alternatives: ***Alternative SED-1*** (no action) would be the lowest cost alternative. The cost for ***Alternative SED-2*** (CDF) would be greater than costs for Alternative SED-1 and SED-3 if construction of the CDF is required to meet ch. NR 504, WAC specifications and armouring to the top of the sheet pile is required on the lake side. The cost to implement ***Alternative SED-3*** (subaqueous capping of a portion of the sediment and removal of the remainder) would range between approximately $37 to 48 million depending upon whether the sediment is thermally treated or not. The cost to implement ***Alternative SED-4*** (dredging) would range between approximately $50 to 67 million depending upon whether the sediment is mechanically or hydraulically dredged and whether it is thermally treated. Costs for implementation of ***Alternative SED-5*** (dry excavation) would range between approximately $79 to 92 million depending upon whether the sediment is thermally treated. Costs for ***Alternative SED-6*** (combination of dredging and dry excavation) would range between $68 and 80 million depending upon how the sediment is dredged and whether it is thermally treated. Alternative capping designs, for instance a three-foot cap (two feet of sand and one foot of rock for erosion control) with a carbon mat (three-feet of sand and one-foot of rock) would be several million dollars less than the four-foot cap upon which the cost estimates for ***Alternative SED-3*** is based.

8. State/Support Agency Acceptance

State Agency acceptance of the preferred alternative will be determined after receiving public comments. Currently, WDNR concurs with the Preferred Alternative described in this Proposed Plan.

9. Community Acceptance

Community acceptance of the preferred alternative will be evaluated after the public comment period ends and will be described in the ROD for the site.

EPA's Preferred Alternative

To organize all of these cleanup alternatives for soil, ground water and sediment into workable combinations, the feasibility study formed ten cleanup "scenarios." The scenarios are summarized in a chart on Page 31.

Soil

EPA believes the limited removal and thermal treatment option (S-5A) will achieve the best balance among the threshold and balancing criteria because a significant mass of contaminated soil will be removed. EPA recommends treating contaminated soil after removal. If this is not cost-effective, then off-site disposal is recommended. This alternative will significantly reduce exposure from soil contamination to people and wildlife, will comply with federal and state regulations, and is a cost-effective way to manage the most contaminated material. The "no action" option would not protect human health and the environment. Although unlimited removal and off-site disposal would provide a high level of human health and environmental protection, limited removal would also provide a high level of protection but at a lower cost. Containment of contaminated materials and on-site disposal of contaminated material would limit access to people and wildlife and would result in reduced risk. However, the overall level of protection in containment and on-site disposal would be lower because there is no reduction of contaminant mass and contaminants would remain on site.

Ground Water

EPA proposes using engineered surface and vertical barriers with hydraulic containment for the shallow ground water in Kreher Park and the Upper Bluff/Filled Ravine (GW-2A). For the Copper Falls aquifer EPA recommends enhanced ground water extraction (GW-9B). In addition, in-place treatment (GW-6 or GW-3) can be used to possibly enhance ground water cleanup since treatment results in the removal of a significant amount of contamination. The purpose of this groundwater cleanup alternative is hydraulic containment within the waste management area and restoration of the aquifer outside the waste management area. EPA believes using containment with surface and vertical barriers, ground water extraction with treatment, and possible in-place treatment will achieve the best balance among the nine criteria. The actual length of time necessary to operate extraction and treatment systems will be determined by considering the progress of the system during the cleanup period. The "no action" alternative would not protect human health and the environment.

Sediment
EPA proposes that the best way to handle the near-shore contaminated sediment and wood debris would be dry removal, with dredging of off-shore contaminated sediment and wood debris (SED-6). Dry dredging would address concerns over the possible release of free product in the wood waste and sediment into the water of the bay which could potentially recontaminate areas that had been cleaned up. In addition, before any sediment removal is conducted, controls would be put in place to make sure that sediment will not be recontaminated. For example, a barrier would be placed between upland areas in Kreher Park and the bay to prevent the recontamination of bay sediments after the dredge. EPA recommends treating contaminated sediment after removal. If this is not cost-effective, then off-site disposal is recommended. The combination of dry excavation and dredging and treatment is protective of human health and the environment because it results in the decontamination of sediment and removes it from the environment. If the sediment were to be sent to a landfill for disposal without treatment it would still be contaminated though there would be no exposure to people or wildlife. Dry excavation, dredging and treatment and/or disposal complies with federal and state regulations and provides the highest level of effectiveness over the long term. The dry excavation of the inner bay and dredging the outer bay is less expensive than a dry excavation of the entire bay, but more expensive than dredging the whole bay. The dry excavation of the inner bay is cost-effective considering the following: its short-term effectiveness in removing wood debris and free product compared to dredging the inner bay; its long-term effectiveness in removing wood debris and free product compared to dredging the inner bay which could result in recontamination of sediments as free product is released into the water; and the reduction in toxicity, mobility and volume of the waste that dry excavation can achieve with thermal treatment.

Summary
EPA concluded the "no action" scenario would not protect people or the environment and eliminated it from consideration. EPA recommends Scenario 10 from the feasibility study:

- Sediment cleanup in Chequamegon Bay would be a combination of dry removal (inner bay) and dredging (outer bay) with thermal treatment and/or disposal of removed sediment and wood waste.
- Soil cleanup at Kreher Park and the Upper Bluff/ Filled Ravine would be limited soil removal with thermal treatment or off-site disposal.
- Ground water cleanup for shallow ground water at the Upper Bluff/Filled Ravine and Kreher Park would be engineered surface and vertical barriers with ground water extraction. Ground water cleanup at the Copper Falls aquifer would be enhanced ground water extraction. Also recommended is using in-place treatment to enhance ground water treatment and extraction. Ground water cleanup and monitoring will continue for a long period of time.

Scenario 10 is recommended because it will achieve substantial risk reduction by treating the source materials (free product, NAPLs) that are the principal threat wastes at the site and safely manage any contaminants that remain at the site after the cleanup is complete. If thermal treatment is not feasible based on pre-design studies or the cost is significantly higher, the contaminated soil and sediment would be disposed off-site. This combination reduces risk sooner and costs are less than some of the other scenarios. Scenario 10 will take a number of years to complete. The estimated cost is between $83.4 million and $97.5 million.

Based on the information currently available, EPA believes the Preferred Alternative meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria. EPA expects the Preferred Alternative to satisfy the following statutory requirements of CERCLA §121(b): 1) be protective of human health and the environment; 2) comply with ARARs (or justify a waiver); 3) be cost-effective; 4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and 5) satisfy the preference for treatment as a principal element, or explain why the preference for treatment will not be met. The WDNR concurs with EPA's Preferred Alternative.

Community Participation

Before it makes its decision final, EPA will review all statements and written comments received during the public comment period and at the public hearing to be held on June 29, 2009. Based on new information presented in the comments, EPA, in consultation with WDNR, may modify its Preferred Alternative presented in this Proposed Plan or select another scenario outlined in the plan. EPA encourages the public to review and comment on the proposed cleanup plan. Much more detail on the cleanup alternatives and scenarios is available in the official documents on file at the information repositories or EPA's Web site: www.epa.gov/region5/sites/ashland. EPA will respond to the comments in a "responsiveness summary" that will be part of the record of decision that describes the final cleanup plan. The Agency will announce its decision on a cleanup plan in a local newspaper and will place a copy of the record of decision in the repositories and on the Web site.

For more information

The remedial investigation and feasibility study and other documents are available on EPA and WDNR Web sites and at information repositories:

www.epa.gov/region5/sites/ashland
www.dnr.state.wi.us/org/aw/rr/cleanup/ashland.html

Vaughn Public Library
502 W. Main St.
Ashland

Bad River Public Library
100 Maple St.
Odanah

WDNR Spooner Service Center
810 W. Maple St.
Spooner

Red Cliff Environmental Protection
Agency Office
86395 Hwy. 13, Brood Stock Building
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Table 1
Summary of RME Carcinogenic and Non-carcinogenic Risks

Receptor	Soil		Oily Materials in Surface Water		Sediment		Oily Materials in Groundwater		Biota		Indoor Air	
	CR	HI	CR	HI	CR	HI	CR	HI	CR	HI	CR	HI
Resident	**5×10^{-4}**	**15**	–	–	–	–	–	–	–	–		
Recreational Adult	3×10^{-6}	0.002	–	–	–	–	–	–	–	–	–	–
Recreational Adolescent	2×10^{-6}	0.003	–	–	–	–	–	–	–	–	–	–
Recreational Child	1×10^{-5}	0.04	–	–	–	–	–	–	–	–	–	–
Adult Swimmer	–	–	**9×10^{-2}**	**6**	5×10^{-9}	2×10^{-5}	–	–	–	–	–	–
Adolescent Swimmer	–	–	–	–	3×10^{-9}	2×10^{-5}	–	–	–	–	–	–
Adult Wader	–	–	**5×10^{-2}**	**4**	1×10^{-5}	0.002	–	–	–	–	–	–
Adolescent Wader	–	–	–	–	5×10^{-6}	0.002	–	–	–	–	–	–
Industrial Worker	6×10^{-6}	0.007	–	–	–	–	–	–	–	–	**8×10^{-5}**	3
Maintenance Worker	1×10^{-6}	0.001	–	–	–	–	–	–	–	–	–	–
Construction Worker	**1×10^{-4}**	**38**	–	–	–	–	**7×10^{-3}**	**59.5**	–	–	**8.34E-03 (KP) 2.14E-05 (UB) 3.29E-02 (FR)**	17152 (KP) 228 (UB) 646601 (FR)
Subsistence Fisher	–	–	–	–	–	–	–	–	**1×10^{-4}**	0.01	–	–

RME – reasonable maximum exposure
CR – cancer risk
HI – hazard index

KP – Kreher Park
UB – Upper Bluff
FR – Filled Ravine

Ashland/NSP scenarios 1-10 comparison chart		Cost	Overall protection of human health and the environment	Compliance with applicable or relevant and appropriate requirements	Long-term effectiveness and permanence	Reduction of toxicity, mobility or volume through treatment	Short-term effectiveness	Implementability
Scenario 1	**Under this option no cleanup work would be performed and all contamination would be left in place.**	**$0**	○	○	○	○	○	●
Sediment	No action (Sed-1)							
Soil	No action (S-1)							
Ground water	No action (GW-1)							
Scenario 2	**This is the least expensive scenario.**	**$39.9 million**	◉	●	◉	○	◉	●
Sediment	Dredging, treatment and/or disposal, and monitoring (Sed-4)							
Soil	Containment using engineered surface barriers - caps (S-2)							
Ground water	Operate existing ground water extraction system (GW-9A)							
Scenario 3	**Estimated costs are dominated by sediment removal and enhanced ground water treatment.**	**$89.2 - $104.4 million**	●	●	●	◉	◉	●
Sediment	Dredging, treatment and/or disposal, and monitoring (Sed-4)							
Soil	Limited removal, off-site disposal, off-site incineration, on-site treatment (S-3A, S-5A, S-5B)							
Ground water	Enhanced ground water extraction, on-site treatment (GW-9B, GW-3, 4, 6, 7)							
Scenario 4	**Estimated costs are dominated by sediment removal.**	**$74.9 - $88.9 million**	●	●	●	◉	◉	●
Sediment	Dredging, treatment and/or disposal, and monitoring (Sed-4)							
Soil	Limited removal, off-site disposal, off-site incineration, on-site treatment (S-3A, S-5A, S-5B)							
Ground water	Containment using engineered surface barriers, vertical barriers, partial caps, on-site treatment (GW-2A, GW-3, 4, 5, 6, 7)							
Scenario 5	**Estimated costs are dominated by construction of the disposal facility.**	**$38.5 - $45.9 million**	◉	◉	◉	○	◉	◉
Sediment	Consolidation, Confined Disposal Facility (CDF), and monitoring (Sed-2)							
Soil	Limited removal, on-site disposal (S-4A)							
Ground water	Enhanced ground water extraction, containment using engineered surface barriers, capping entire Kreher Park, on-site treatment (GW-9B, GW-2B, GW-3, 4, 6, 7, 8)							
Scenario 6	**Estimated costs are dominated by sediment removal.**	**$86 - $103.6 million**	●	●	●	◉	◉	●
Sediment	Dry excavation, treatment and/or disposal, and monitoring (Sed-5)							
Soil	Limited removal, off-site disposal, off-site incineration, on-site treatment (S-3A, S-5A, S-5B)							
Ground water	Operate existing ground water extraction system, containment using engineered surface barriers and partial caps, or capping partial or entire Kreher Park, on-site treatment (GW-9A, GW-2A or 2B, GW-3 through 8)							
Scenario 7	**Estimated costs are dominated by sediment removal.**	**$86.6 - $108.1 million**	●	●	●	◉	◉	●
Sediment	Dry excavation, treatment and/or disposal, and monitoring (Sed-5)							
Soil	Limited soil removal, off-site disposal, off-site incineration, on-site treatment (S-3A, S-5A, S-5B)							
Ground water	Enhanced ground water extraction, on-site treatment (GW-9B, GW-3, 6, 7, 8)							
Scenario 8	**Estimated costs are dominated by sediment removal.**	**$69.2 - $90.4 million**	●	●	●	◉	◉	●
Sediment	Dredging, treatment and/or disposal, and monitoring (Sed-4)							
Soil	Limited removal, off-site disposal, off-site incineration, on-site treatment (S-3A, S-5A, S-5B)							
Ground water	Enhanced ground water extraction, containment using engineered surface barriers and partial caps or capping entire Kreher Park, on-site treatment (GW-9B, GW-2A or 2B, GW-3, 5, 6, 7, 8)							
Scenario 9	**Removing all material from Kreher Park dominates the cost for this most expensive scenario.**	**$123.2 million**	●	●	●	○	◉	●
Sediment	Dry excavation, treatment and/or disposal, and monitoring (Sed-5)							
Soil	Unlimited soil removal, off-site disposal (S-3B)							
Ground water	Enhanced ground water extraction (GW-9B)							
***Scenario 10**	***EPA's recommended alternative. Estimated costs are dominated by sediment removal.***	**$83.4 - $97.5 million**	●	●	●	◉	◉	●
Sediment	Combination of dry excavation and dredging, treatment and/or disposal, and monitoring (Sed-6)							
Soil	Limited soil removal, off-site disposal, off-site incineration, (on-site treatment) (S-5A recommended)							
Ground water	Enhanced ground water extraction, containment using surface and vertical barriers and partial caps, on-site treatment. (GW-9B, GW-2A, GW-3 and GW-6)							

Legend:

○ Does not meet criteria ◉ Partially meets criteria ● Meets criteria